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ABSTRACT

Computers are currently being used to perform medical tasks such as: (1) taking medical histories; (2) patient care and health-unit care management; (3) clinical and laboratory work; (4) physiological signal monitoring; and (5) multiphasic screening. In a survey of over 200 institutions, over 339 computer language applications were found, many of which were developed in-house. The survey showed that commonly used languages such as FORTRAN, COBOL, and PL/1 are used more often than the special purpose languages such as MUMPS, POPS, and PILOT. Findings indicated that FORTRAN is the most adaptable for a wide spectrum of computer memory sizes. The results also showed that almost half the computers used in medical work were of the large main memory type (64K to 3M), and that computer vending was dominated by International Business Machines and Digital Equipment Corporation. This information was intended to provide basic guidelines on the hardware and software likely to be available for developing medicine education curriculums. (EMH)

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SOFTWARE AND HARDWARE UTILIZATION IN COMPUTER MEDICINE EDUCATION

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Introduction

Computer Medicine education has been described as "the first step toward alleviating the medical doctor shortage." The use of CAI and simulation training techniques provides a more timely education vehicle than traditional medical training techniques. Computer medicine provides educational methodology for para-medical personnel as well as aspiring medical doctors.

The computer is being utilized in most phases of medicine on a rapidly increasing basis providing an impetus for medical personnel to be trained in computer medicine. The computer medicine education training package may include all or some of the following training-need areas: (1) Medical histories, (2) Patient care management, (3) Health-unit care management, (4) Clinical decisions, (5) Laboratory, (6) Physiological signal analysis, (7) Multiphasic screening, (8) Drug prescription, (9) Patient monitoring, and (11) Remote consultation.

Over 3,000 medical facilities in the United States utilize one or more of the 11 computerized application areas described previously. Two

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hundred of these facilities were surveyed in order to establish some guidelines on what type of computers were being utilized, languages, size of memory, etc. for future computer-medicine educational development.

Language Usage

In surveying the computer language applications of the 200 facilities, over 339 language applications were found. There were some language duplication and some multiple language usage.

There were a host of small in-house developed languages such as FOPS (File-Oriented Programming System - a multiprogramming, list processing, virtual memory, interpretive system similar to MUMPS) (1,2) and PILOT (Programmed Inquiry, Learning or Teaching - a simple programming language developed by the University of California at San Francisco for CAI, testing, and interview simulation) (3), that were utilized, but provided only a small percentage of the total usage. If the CAI applications are excluded from the language application picture, then the following statistics are available. FORTRAN provided 54% of the language applications, COBOL, 14%, followed by PL/I with 10%, MUMPS (Massachusetts General Hospital Utility Multi-Programming System - an interpretive text processing language developed by Massachusetts General Hospital for medical applications) (4,5,6) and Assembler language both with 6%. These statistics imply that the commonly used languages available such as FORTRAN, COBOL, PL/I, etc. are utilized on a larger percentage basis than the special purpose languages such as MUMPS, FOPS, PILOT, etc. These statistics also provide an implication of the type of hardware needed to utilize this software.

It means that a FORTRAN, COBOL, and PL/1 compiler should be available with the hardware in order to utilize these existing programs. In addition, the general purpose languages dictate a specific memory size (approximately 16K to 32K for the FORTRAN and COBOL compilers). The programming languages cited call letters such as REACH (Real time Electronic Access Communications for Hospitals - an on-line CRT-driven information and communication system developed by National Data Communications, Inc.) (7,8), CAMP (Computer Assisted Menu Planning - a dietary program) (9,10), and MEDLARS (Medical Literature Analysis and Retrieval System of the National Library of Medicine) (11), which in themselves may be written in one of the common programming languages such as FORTRAN, PL/1, MUMPS, etc.

Language Memory Sizes

In order to assess the type or size of main memory needed for each of these languages, statistics were gathered from the survey concerning the size of memory for each language utilized. FORTRAN, which was the most commonly used language in the articles referenced, utilized a 16K computer for a large percentage of its applications, but in addition utilized 256K main memory size for some of its applications. It appears that languages like MUMPS are utilized with the larger machines of 64K to 256K, PL/1 with machines of 16K to 256K, while languages such as Assembly language and FOPS are utilized on the smaller machines of 8K. These findings indicate that FORTRAN is not only one of the most widely used languages found, but is also the most adaptable for the wide spectrum of memory sizes. In other words, different memory sizes have dictated a smaller or larger version of the FORTRAN compiler while special purpose languages such as MUMPS and FOPS

are developed either for the smaller machines or the larger machines and have not been refined or redeveloped to fit the intermediate memory sized machines.

Machine Main Memory Sizes

The main memory sizes ranged from a small of 4K which is 4,000 bytes of main memory to a large of 3M which is 3 million bytes of main memory. 22.5% of all the machines found utilized a main memory size of 256K which can be considered a large computing system. 53.25% of the machines used a 32K main memory size or smaller which leaves approximately 46.75% of machines utilizing 64K to 3M memory sizes. This again indicates that almost half of all the computing machinery surveyed were of a large main memory size.

Machines By Vendor

Because the selection of software is directly dependent on the type of hardware being utilized, we felt it necessary to investigate all the different types of hardware utilized in the 200 facilities surveyed. IBM with its 360,370 and 1100, 1400 and 1800 series dominated usage with 48.75%. This can be expected, of course, because IBM is the giant in computer vending and will normally maintain an upper hand in percentages in any area of application. The DEC vendor with its PDP-8 through PDP-15 provided 20% of the computing machinery found in the articles surveyed. This is not surprising because DEC equipment has been always widely known as a small computing system with varied capabilities. DEC systems provide analog to digital (A-D) and digital to analog (D-A) converter capability which is a necessity in medical applications. Honeywell provided 6% of the

vending equipment found utilized by hospitals and medical institutions. Followed with a smattering of Hewlett-Packard, Univac, Link-8's and CDC equipment. It is obvious that the DEC equipment outclasses all the computing vendors in terms of percentage usage, simply because it is not the second leading vendor of computing equipment in the United States, yet it provides the second largest percentage in the medically oriented programs.

Conclusion

It is hoped that this survey illuminates the types of hardware, software languages, etc. that the computer medicine educator will have to contend with in the real world. This information should provide basic guidelines for developing computer medicine education curriculums for providing the most up-to-date training.

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